Unit 05

Physical States of Matter

Long Answer Questions

Q1. Explain the typical properties of gases.

Ans. Typical properties of gases

There are following typical properties of gases.

(i) Diffusion

Diffusion is defined as "spontaneous mixing up of molecules by random motion and collisions to form a homogeneous mixture" Gases can diffuse very rapidly. Rate of diffusion depends upon the molecular mass of the gases. Lighter gases diffuse rapidly than heavier ones.

Example

H_2 diffuses four times faster than O_2 gas

(ii) Effusion

It is escaping of gas molecules through a tiny hole into a space with lesser pressure.

Example

When a tyre gets punctured, air effuses out. Effusion depends upon molecular masses lighter gases effuse faster than heavier gases

(iii) Pressure

Gas molecules are always in continuous state of motion. Hence when molecules strike with the walls of the container or any other surface, they exert pressure. Pressure (P) is defined as the force (F) exerted per unit surface area (A).

$$P = F/A$$

The SI unit of force is Newton and that of area is m^2. Hence pressure has SI unit of Nm^{-2} .It is also called Pascal (Pa)

$$\text{One Pascal (Pa)} = 1Nm^{-2}$$

Barometer is used to measure atmospheric pressure and manometer is used to measure pressure in the laboratory.

Standard atmospheric Pressure

It is the pressure exerted by the atmosphere at the sea level. It is defined as the pressure exerted by a mercury column of 760 mm height at sea level. It is sufficient pressure to support a column of mercury 760 mm in height at sea level.

1 atm = 760mm of Hg = 760 torr (1mm of Hg = one torr)
= 101325 Nm^{-2} = 101325Pa

(iv) Compressibility

Gases are highly compressible due to empty spaces between their molecules. When the gases are compressed, the molecules come closer to one another and occupy less volume as compared to the volume in uncompressed state.

(v) Mobility

Gas molecules are always in state of continuous motion. They can move from one place to another because gas molecules possess very high kinetic energy. They move through empty spaces that are available for the molecules to move freely. This mobility or random motion results in mixing up of gas molecules to produce a homogeneous mixture.

(vi) Density of Gases

Gases have low density than liquids and solids. It is due to light mass and more volume occupied by the gas molecules. Gas density is expressed in grams per dm^3. Whereas, liquid and solid densities are expressed in grams per cm^3 i.e. liquids and solids are 1000 times denser than gases. The density of gases increases by cooling because their volume decreases. For example, at normal atmospheric pressure, the density of oxygen gas is 1.4 g dm^{-3} at 20^0C and 1.5 g dm^{-3} at 0.0 ^0C.

Q2. Define Boyle's law and verify it with an example.

Ans. Boyle's Law

Introduction

In 1662 Robert Boyle studied the relationship between the volume and pressure of a gas at constant temperature.

Definition

The volume of a given mass of a gas is inversely proportional to its pressure provided the temperature remains constant.

Mathematical expression

According to this law the volume (V) of a given mass of a gas decreases with the increase of pressure (P) and vice versa. Mathematically it can be written as:

$$\text{Volume} \propto \frac{1}{\text{Pressure}} \quad \text{or} \quad V \propto \frac{1}{P}$$

$$\text{or} \quad V = \frac{k}{P} \quad \text{or} \quad VP = k = \text{constant}$$

Where 'k' is proportionality constant. The value of k is same for the same amount of a given gas

Another form of Boyle's law

Boyle's law can be stated as "the product of pressure and volume of a fixed mass of a gas is constant at a constant temperature".

If $P_1V_1 = k$ Then $P_2V_2 = k$

Where P_1 = initial pressure $\quad$ P_2=final pressure

V_1 = initial volume $\quad$ V_2=final volume

As both equations have same constant therefore, their variables are also equal to each other.

$$(\therefore P_1V_1 = P_2V_2)$$

This equation establishes the relationship between pressure and volume of the gas.

Experimental Verification of Boyle's law

The relationship between volume and pressure can be verified experimentally by the following series of experiments. Let us take some mass of a gas in a cylinder having a movable piston and observe the effect of increase of pressure on its volume. The phenomenon is represented in figure. When the pressure of 2 atmosphere (atm) is applied, the volume of the gas reduces as 1 dm^3. When pressure is increased equivalent to 4 atm, the volume of the gas reduces to 0.5 dm^3. Again when pressure is increased three times i.e. 6 atm, the volume reduces to 0.33 dm^3. Similarly, when pressure is increased up to 8 atm on the piston, volume of the gas decreases to 0.25 dm^3.

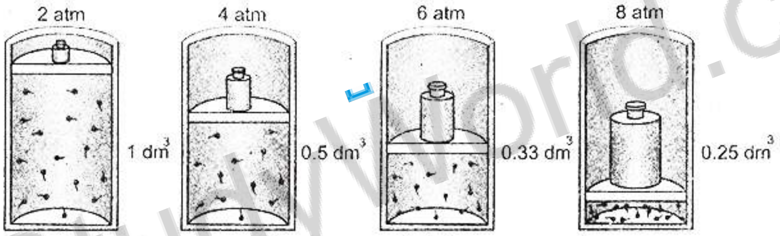

Fig. The decrease of volume with increase of pressure.

When we calculate the product of volume and pressure for this experiment, the product of all these experiments is constant i.e. 2 atm dm^3. It proves the Boyle's law

P_1V_1 = 2 atm x 1 dm^3 = 2 atm dm^3

P_2V_2 = 4 atm x 0.5 dm^3 = 2 atm dm^3

P_3V_3 = 6 atm x 0.33 dm^3 = 2 atm dm^3

P_4V_4 = 8 atm x 0.25 dm^3 = 2 atm dm^3

Q.3 In which units blood pressure is measured?

Ans. Blood pressure is measured

Blood pressure is measured using a pressure gauge. It may be a mercury manometer or some other device. Blood pressure is reported by two values, such as 120/80, which is a normal blood pressure. The first measurement shows the maximum pressure when the heart is pumping. It is called systolic pressure. When the heart is in resting position, pressure decreases and it is the second value called diastolic. Both of these pressures are measured in torr units. Hypertension is because of high blood pressure due to tension and worries in daily life. The usual criterion for hypertension is a blood pressure greater than 140/90. Hypertension raises the level of stress on the heart and on the blood vessels. This stress increases the susceptibility of heart attacks and strokes.

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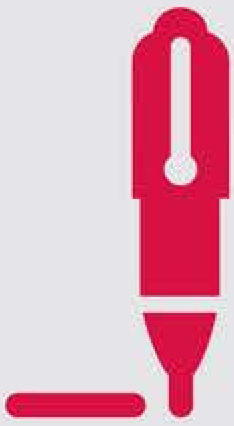

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Q.4. Define and explain Charles Law of gases.

Ans. Charles Law

Introduction

French scientist J. Charles in 1787 presented his law

Definition

The volume of a given mass of a gas is directly proportional to the absolute temperature if the pressure is kept constant."

Mathematical expression

When pressure P is constant, the volume V of a given mass of a gas is proportional to absolute temperature T. Mathematically it is represented as:

$$\text{Volume} \propto \text{temperature} \quad \text{or} \quad V \propto T$$

$$\text{or} \quad V = kT \qquad \text{or} \quad \frac{V}{T} = k$$

Where k is proportionality constant. If temperature of the gas is increased its volume also increases. When temperature is changed from T_1 to T_2 the volume changes from V_1 to V_2. The mathematical form of Charles Law will be:

$$\frac{V_1}{T_1} = k \quad \text{and} \quad \frac{V_2}{T_2} = k$$

As both equations have same value of constant, therefore, their variables are also equal to each other.

So $$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

Experimental Verification of Charles Law

Let us take a certain amount of gas enclosed in a cylinder having a moveable piston. If the initial volume of the gas V_1 is $50cm^3$ and initial temperature T_1 is $25°C$, on heating the cylinder up to 100^0C, its new volume V_2 is about $62.5cm^3$. The increase in temperature increases the volume that can be observed as elaborated below in the figure.

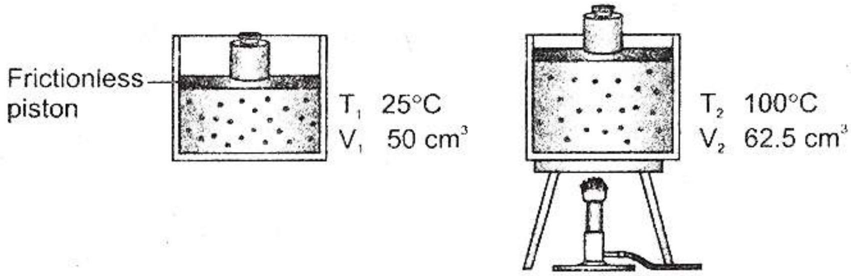
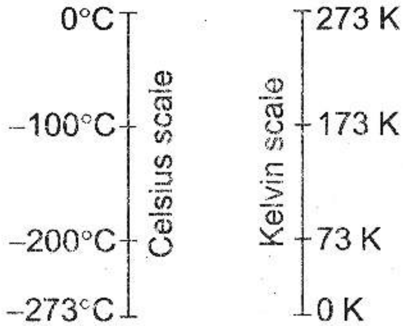


Fig. 5.2: Representation of increase of volume with the increase of temperature.

Q.5. Explain Absolute Temperature Scale.

Ans. Absolute Temperature Scale:

Lord Kelvin introduced absolute temperature scale or Kelvin scale. This scale of temperature starts from 0 K or -273.15 ^oC , which is given the name of absolute zero. It is the temperature at which an ideal gas would have zero volume. As both scales have equal degree range, therefore, when 0 K equal to -273^oC then 273 K is equal to 0^oC as shown in the scales.



Conversion of Kelvin temperature to Celsius temperature and vice versa can be carried out as follows.

$$(T)\ K = (T)\ ^0C + 273$$

$$(T)\ ^0C = (T)\ K - 273$$

Q.6. Explain the physical states of matter and role of intermolecular forces:

Ans. The physical states of matter and role of intermolecular forces:

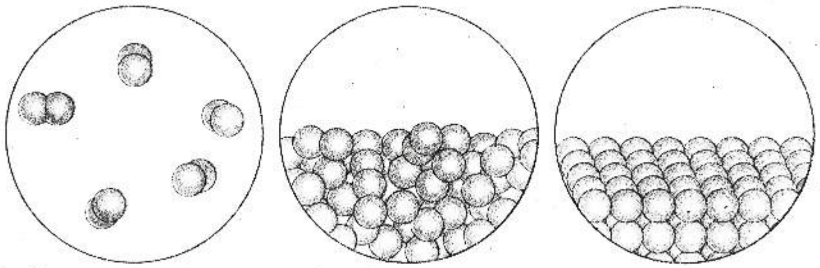
Matter exists in three physical states; gas, liquid and solid.

Gaseous state of matter

In the gaseous state, the molecules are far apart from each other. Therefore, intermolecular forces are very weak in them.

Liquid state of matter:

In the liquid state molecules are much closer to each other as compared to gases as shown in figure. As a result liquid molecules develop stronger intermolecular forces, which affect their physical properties like diffusion, evaporation, vapour pressure and boiling point. Compounds having stronger intermolecular forces have higher boiling points.



A. Gas molecules **B. Liquid molecules** **C. Solid molecules**

Fig: Three states of matter showing intermolecular forces.

Solid state of matter

The intermolecular forces become so dominant in solid state that the molecules look motionless. They arrange in a regular pattern therefore they are denser than molecules of liquids.

Q.7. Define and Explain Evaporation. On which factors evaporation depends?

Ans. Evaporation

The process of changing of a liquid into a gas phase is called evaporation.

It is reverse to condensation in which a gas changes into liquid.

Evaporation is an endothermic process

Evaporation is an endothermic process (heat is absorbed). Such as when one mole of water in liquid state is converted into vapour form, it requires 40.7 kJ of energy.

$$H_2O_{(l)} \longrightarrow H_2O_{(g)} \qquad \Delta H^0_{vap} = 40.71\,kJmol^{-1}$$

Process of evaporation;

In the liquid state, molecules are in a continuous state of motion. They possess kinetic energy but all the molecules do not have same kinetic energy. Majority of the molecules have average kinetic energy and a few have more than average kinetic energy. The molecules having more than average kinetic energy overcome the attractive forces among the molecules and escape from the surface. It is called as evaporation.

Relation of evaporation and temperature

Evaporation is a continuous process taking place at all temperatures. The rate of evaporation is directly proportional to temperature. It increases with the increase in temperature because of increases in kinetic energy of the molecules.

Evaporation is a cooling process

When the high kinetic energy molecules vapourize, the temperature of remaining molecules falls down. To compensate this deficiency of energy, the molecules of liquid absorb energy form the surroundings, as a result the temperature of surroundings decreases and we feel cooling. For example, when we put a drop of alcohol on palm, the alcohol evaporates and we feel cooling effect.

Factors Affecting Evaporation:

Evaporation depends upon following factors.

i. Surface area

Evaporation is a surface phenomenon. Greater is surface area, greater, is evaporation and vice verse.

Example

Sometimes a saucer is used if tea is to be cooled quickly. This is because evaporation from the larger surface area of saucer is more that that form the smaller surface area of a tea cup.

ii. Temperature

At high temperature, rate of evaporation is high because at high temperature kinetic energy of the molecules increases so high that they overcome the intermolecular forces and evaporate rapidly.

Example

Water level in a container with hot water decreases earlier than that of a container with cold water, this is because the hot water evaporates earlier than the cold water.

iii. Intermolecular forces:

If intermolecular forces are stronger, molecules face difficulty in evaporation.

Example

Water has stronger intermolecular forces than alcohol, therefore, alcohol evaporates faster than water.

Q8. What is vapour pressure and how it is affected by intermolecular forces?

Vapour pressure

The pressure exerted by the vapour of a liquid at equilibrium with the liquid at a particular temperature is called vapour pressure of a liquid.

The equilibrium is a state when rate of vaporization and rate of condensation is equal to each other but in opposite directions.

$$\text{Liquid} \underset{\text{Condense}}{\overset{\text{Vapourize}}{\rightleftharpoons}} \text{Vapours}$$

Explanation

From the open surface of a liquid, molecules evaporate and mix up with the air but when we close a system, evaporated molecules start gathering over the liquid surface. Initially the vapours condense slowly to return to liquid. After sometime condensation process increases and a stage reaches when the rate of evaporation becomes equal to rate of condensation. At that stage the number of molecules evaporating will be equal to the number of molecules coming back (condensing) to liquid. This state is called dynamic equilibrium as a shown in figure.

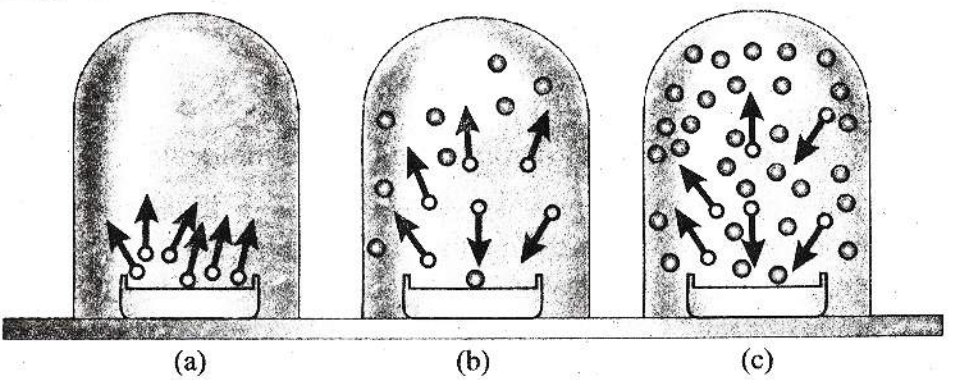


Fig. A state of dynamic Equilibrium between liquid and its vapours

Factors affecting vapour pressure

Vapour pressure of liquid depends upon the following factors.

i. Nature of liquid

Vapour pressure depends upon the nature of liquid. Polar liquids have low vapour pressure than non-polar liquids at the same temperature. This is because of strong intermolecular forces between the polar molecules of liquids.

Example

Water has less vapour pressure than that of alcohol at same temperature.

ii. Size of molecules

Small size molecules can easily evaporate than big size molecules. Hence; small size molecules exert more pressure.

Example

Hexane (C_6H_{14}) is a small sized molecule as compared to decane ($C_{10}H_{22}$). C_6H_{14} evaporates rapidly and exert more pressure than $C_{10}H_{22}$.

iii. Temperature

At high temperature, vapour pressure is higher than at low temperature. At elevated temperature, the kinetic energy of the molecules increases enough to enable them to vapourize and exert pressure.

For example, vapour pressure of water at different temperatures is given in the Table

Temp^{0}C	Vapour pressure mm Hg	Temp^{0}C	Vapour Pressure mm Hg
0	4.58	60	149.4
20	17.5	80	355.1
40	55.3	100	760.0

Q9. Define Boiling Point and also explain how it is affected by different factors?

Ans. Boiling Point

The temperature at which the vapour pressure of a liquid becomes equal to the atmospheric pressure or any external pressure is called a boiling point.

Explanation

When a liquid is heated, its molecules gain energy. The number of molecules which have more than average kinetic energy increases. More and more molecules become energetic enough to overcome the intermolecular forces. Due to this, rate of evaporation increases that results in increase of vapour pressure until a stage reaches where the vapour pressure of a liquid becomes equal to atmospheric pressure. At this stage the liquid starts boiling.

The following figure shows the increases of vapour pressure of diethyl ether, ethyl alcohol and water with the increases of temperature. At 0°C the vapour pressure of diethyl ether is 200mm Hg, of ethyl alcohol 25mm Hg while that of water is about 5 mm Hg. When they are heated vapour pressure of diethyl ether increases rapidly and becomes equal to atmospheric pressure at 34.6°C, while vapour pressure of water increases slowly because intermolecular forces of water are stronger. The figure also shows that the vapour pressure increases very rapidly when the liquids are near to boiling point

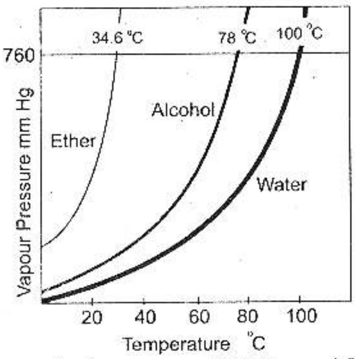


Fig. Boiling point curves of Ether, Alcohol and Water

Factors affecting the boiling point:

The boiling point of the liquid depends upon the following factors.

i. Nature of liquid

The polar liquids have high boiling points than that of non-polar liquids because polar liquids have difficulty in evaporation.

ii. Intermolecular forces

Intermolecular forces play a very important role on the boiling point of liquids. Substances having stronger intermolecular forces have high boiling points, because such liquids attain a level of vapour pressure equal to external pressure at high temperature.

iii. External pressure

Boiling point of a liquid depends upon external pressure. Boiling point of a liquid is controlled by external pressure in such a way, that it can be increased by increasing external pressure and vice verse. This principle is used in the working of "pressure Cooker""

Q10. Define Freezing point and explain, on what factors it depends?

Ans. Freezing point

Freezing point of a liquid is that temperature at which vapour pressure of liquid state is equal to the vapour pressure of the solid state. At this temperature liquid and solid coexist in dynamic equilibrium with one another.

Explanation

When liquids are cooled the vapour pressure of liquid decreases and a stage reaches when vapour pressure of a liquid state becomes equal to the vapour pressure of the solid state.

At this temperature liquid and solid coexist in dynamic equilibrium with one another and this is called the freezing point of a liquid.

Freezing point depends upon the following factors

1. Size
2. Intermolecular Forces
3. Shape

Table Freezing point and Boiling Points of Common Liquids

Sr.	Liquid	Freezing point ^0C	Boiling point ^0C
1	Diethyl ether	-116	34.6
2	Ethyl alcohol	-115	78
3	Water	0.0	100
4	n-Octane	-57	126
5	Acetic acid	16.6	118

Q11. Describe the phenomenon of diffusion in liquids along with factors which influence it.

Ans. Diffusion in liquids

The liquid molecules are always in a state of continuous motion. They move from higher concentration to lower concentration. They mix up with the molecules of other liquids, so that they form a homogeneous mixture.

Example

When a few drops of ink are added in a beaker of water, ink molecules move around and after a while spread in whole of the beaker. Thus diffusion has taken place. Liquids diffuse like gases but the rate of diffusion of liquid is very slow.

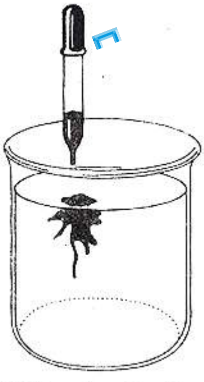


Fig. Diffusion in liquids

Factors which affect diffusion in liquids:-

The diffusion of liquid depends upon the following factors.

i. Intermolecular forces

Liquids having weak intermolecular forces diffuse faster than those having strong inter molecular forces

ii. Size of molecules

Big size molecules diffuse slowly. For example, honey diffuses slowly in water than that of alcohol in water.

iii. Shapes of molecules

Regular shaped molecules diffuse faster than irregular shaped molecules because they can easily slip over and move faster.

iv. Temperature

Diffusion increases by increasing temperature because at high temperature the intermolecular forces are weak.

Q12. Explain the density of liquid.

Ans. Density of liquid

The density of liquid depends upon its mass and volume. Liquids are denser than gases because molecules of liquid are closely packed and the spaces between their molecules are negligible. As the liquid molecules have strong intermolecular forces hence they cannot expand freely and have a fixed volume. Like gases, they cannot occupy all the available volume of the container that is the reason why densities of liquids are high.

Example

Density of water is 1.0 $g\ cm^{-3}$ while that of air is 0.001 gcm^{-3} .That is the reason why drops of rain fall downward. The densities of liquids also vary. You can observe kerosene oil floats over water while honey settles down in the water

Q.13. Explain typical properties of solids state.

Ans. Solid State

It is third state of matter which has definite shape and volume. In solid state the molecules are very close to one another and they are closely packed. The intermolecular forces are so strong that particles become almost motionless. Hence they cannot diffuse. Solid particles possess only vibrational motion.

Typical Properties of Solids

Solids exhibit typical properties, a few of which are discussed here.

i. Melting Point

The temperature at which the solid starts melting and coexists in dynamic equilibrium with liquid state is called melting point.

Explanation

The solid particles possess only vibrational kinetic energy. When solids are heated, their vibrational energies increase and particles vibrate at their mean position with a higher speed. If the heat is supplied continuously, a stage reaches at which the particles leave their fixed positions and then become mobile. At this temperature solid melts. The ionic and

covalent solids make network structure to form macromolecules. So all such solids have very high melting points.

$$\text{Solid} \rightleftharpoons \text{Liquid}$$

ii. Rigidity

The particles of solids are not mobile. They have fixed positions. Therefore, solids are rigid in their structure.

iii. Density

Solids are denser than liquids and gases because solid particles are closely packed and do not have empty spaces between their particles. Therefore, they have the highest densities among the three states of matter. For example, density of aluminum is $2.70gcm^{-3}$, iron is $7.86gcm^{-3}$ and gold is $9.3gcm^{-3}$.

Q.14.Explain types of solids.

Ans. Types of Solids

According to their general appearance solids can be classified into two types: amorphous solids and crystalline solids.

i. Amorphous Solids

Amorphous means shapeless. Solids in which the particles are not regularly arranged or their regular shapes are destroyed, are called **amorphous solids.**

Properties of Amorphous Solids

They do not have sharp melting points.

Example

Plastic, rubber and even glass are amorphous solids as they do not have any sharp melting points.

ii. Crystalline Solids

Solids in which particles are arranged in a definite three-dimensional pattern are called **crystalline solids.**

Properties of Crystalline solids

They have definite surfaces or faces. Each face has definite angle with the other. They have sharp melting points.

Examples

Diamond, sodium chloride etc.

Q15. Define Allotropy and explain it.

Ans. Allotropy:

The existence of an element in more than one forms in same physical state is called allotropy.

Allotropy is due to:

i. The existence of two or more kinds of molecules of an element each having different number of atoms such as allotropes of oxygen are oxygen (O_2) and **ozone (O_3)**

ii. Different arrangement of two or more atoms or molecules in a crystal of the element. Such as, sulphur shows allotropy due to different arrangement of molecules (S_8) in the crystals.

They always show different physical properties but may have same or different chemical properties.

Transition temperature

The temperature at which one allotrope changes into another is called **transition temperature**

Examples

1) Transition temperature of sulphur is 96°C. Below this temperature rhombic form is stable. If rhombic form is heated up to 96°C. Its molecules rearrange themselves to give monoclinic form.

$$S_8\ \text{(rhombic)} \xrightleftharpoons{96^{o}C} S_8\ \text{(monoclinic)}$$

Other examples are tin and phosphorus.

$$P_4\ \text{(white)} \xrightleftharpoons{25^{o}C} (P_4)_n\ \text{(red}$$

$$\text{Sn grey (cubic)} \xrightleftharpoons{18^{o}C} \text{Sn}_{\text{White}}\ \text{(tetragonal)}$$

White phosphorus is very reactive, poisonous and waxy soft solid. It exists as tetra-atomic molecules. While red phosphorous is less reactive, non-poisonous and brittle powder.

Q.16. Explain the curing with salt to preserve meat.

Ans. Curing with salt to preserve meat

Table salt is the most important ingredient for curing meat and is used in large quantities. Salt kills and inhibits the growth of putrifying bacteria by drawing water out of the meat. Concentrations of salt up to 20% are required to kill most species of unwanted bacteria. Once properly salted, the meat contains enough salt to prevent the growth of many undesirable microbes.

Q.17. Explain change of instrumentation as the science progress.

Ans. Change of instrumentation as the science progress.

There are many aspects to be considered about the functioning of instruments. Scientific observation is determined by the human sensory system. It generally relies on instruments that serve as mediators between the world and the senses. Thus, instruments can be considered as a reinforcement of the senses. They provide a great capacity for increasing the power of observation and making induction processes easier. Furthermore, scientific instruments constitute a major factor in checking, refuting or changing previously established theories.

Solved Examples of Book

Example 5.1

A gas with volume 350 cm^3 has a pressure of 650 mm of Hg. If its pressure is reduced to 325 mm of Hg, calculate what will be its new volume?

Data

$V_1 = 350\ cm^3$

$P_1 = 650$ mm of Hg

$P_2 = 325$ mm of Hg

$V_2 = ?$

Solution

By using the equation of Boyle's Law

$$P_1V_1 = P_2V_2$$

$$\text{or} \quad V_2 = \frac{P_1V_1}{P_2}$$

By putting the values

$$V_2 = \frac{650 \times 350}{325}$$

$$= 700 cm^3$$

Thus volume of the gas is doubled by reducing in pressure to half.

Example 5.2

785 cm^3 of a gas was enclosed in a container under a pressure of 600 mm Hg. If volume is reduced to 350 cm^3, what will be the pressure?

Data

$V_1 = 785\ cm^3$

$P_1 = 600$ mm of Hg

$V_2 = 350\ cm^3$

$P_2 = ?$

Solution:

By using the Boyle's equation

$$P_1V_1 = P_2V_2$$

$$\text{or} \quad P_2 = \frac{P_1V_1}{P_2}$$

By putting the values

$$P_2 = \frac{785 \times 600}{350} = 1345.7 \text{mm of Hg}$$

$$\text{or } P_2 = \frac{1345.7}{760} = 1.77\text{atm}$$

Thus pressure is increased by decreasing volume.

Example 5.3

A sample of oxygen gas has a volume of 250 cm^3 at -30 ^{0}C. If gas is allowed to expand up to 700 cm^3 at constant pressure, find out its final temperature.

$V_1 =$ 250 cm^3

$T_1 =$ -30 ^{0}C = 243 K

$V_2 =$ 700cm^3

$T_2 =$?

Solution

By using the equation

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$T_2 = \frac{V_2 T_1}{V_1}$$

By putting the value in equation

$$T_2 = \frac{700 \times 243}{250} = 680.4 \text{ K}$$

Thus expansion is caused due to increasing temperature.

Example 5.4

A sample of hydrogen gas occupies a volume 160 cm^3 at 30^{0}C. If its temperature is raised to 100^{0}C, calculate what will be its volume if the pressure remains constant.

$V_1 =$ 160 cm^3

$T_1 =$ 30^{0}C = 303 K (as 0 ^{0}C =273K)

$T_2 =$ 100^{0}C = 373 K

$V_2 =$?

Solution

By using the equation of Charles's Law

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$\text{or } V_2 = \frac{V_1 T_2}{T_1}$$

By putting the values in above equation

$$V_2 = \frac{160 \times 373}{303} = 196.9\text{cm}^3$$

Thus volume of the gas has increased by raising the temperature.

Numericals

1) Convert the following units:

a. 850 mm Hg to atm b. 205000 Pa to atm.

c. 560 torr to cm Hg d. 1.25 atm to Pa

Ans. a. 850 mm Hg to atm

Solution

Atm	=	**mm of Hg**
1		760
x		850

$$x = \frac{850}{760}$$

$$= 1.12 \text{ atm}$$

b. 205000 Pa to atm.

Solution

Pa	=	**Atm**
101325		1
205000		x

$$x = \frac{205000}{101325}$$

$$= \mathbf{2.02 \text{ atm}}$$

c. 560 torr to cm Hg

Solution

Torr	=	**Cm Hg**
1		.01cmHg
560		x

$$x = 560 \times .01$$

$$x = 56 \text{ cm of Hg}$$

d. 1.25 atm to Pa.

Solution

Atm	=	**Pa**
1		101325
1.25		x

$$X = 1.25 \times 101325$$

$$\mathbf{X = 126656 \text{ Pa}}$$

2) Convert the following units:

a. 750^0C to K b. 150^0C to K

c. 100 K to ^0C d. 1.25 K to ^0C

Ans. a. 750^{0}C to K

Solution

$$K = {}^0C + 273$$
$$K = 750 + 273$$
$$K = 1023K$$

b. 150^{0}C to K

Solution

$$K = {}^0C + 273$$
$$K = 150 + 273$$
$$K = 423K$$

c. 100 K to ^{0}C

Solution

$${}^0C = K - 273$$
$${}^0C = 100 - 273$$
$${}^0C = -173\ {}^0C$$

d. 172 K to ^{0}C

Solution

$${}^0C = K - 273$$
$${}^0C = 172 - 273$$
$$= -101\ {}^0C$$

3) A gas at pressure 912 mm of Hg has volume 450cm^3. What will be its volume at 0.4 atm.

Solution

$$P_1 = 912 \text{ mm of Hg} = \frac{912}{760} = 1.2\text{ atm}$$
$$V_1 = 450\text{cm}^3$$
$$V_2 = ?$$
$$P_2 = 0.4\text{atm}$$

Using the equation of Boyle's Law.

$$P_1V_1 = P_2V_2$$

$$\text{or } V_2 = \frac{P_1V_1}{P_2}$$

By putting the values

$$= \frac{1.2 \times 450}{0.4}$$

$$V_2 = 1350 \text{ cm}^3$$

4) A gas occupies a volume of 800 cm^3 at 1 atm, when it is allowed to expand up to 1200 cm^3 what will be its pressure in mm of Hg.

Solution

$$V_1 = 800cm^3$$
$$P_1 = 1atm$$
$$V_2 = 1200cm^3$$
$$P_2 = mm\ Hg = ?$$

Using equation of Boyle's law.

$$P_1V_1 = P_2V_2$$

$$\text{or } P_2 = \frac{P_1V_1}{V_2}$$

By putting the values

$$P_2 = \frac{1 \times 180}{1200}$$
$$= 0.66 \text{ atm}$$
$$1\text{atm} = 760 \text{ mmHg}$$
$$0.66 \text{ atm} = 760 \times 0.66$$
$$= 506.66 \text{ mmHg}$$

5) It is desired to increase the volume of a fixed amount of gas from 87.5 to 118 cm^3 while holding the pressure constant. What would be the final temperature if the intial temperature is 23 ^0C.

Solution

$$V_1 = 87.5 \text{ cm}^3$$
$$V_2 = 118 \text{cm}^3$$
$$T_1 = 23^0C = 296 \text{ K}$$
$$T_2 = ?$$

By using the equations of Charles's law.

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$\text{or } \frac{T_2V_1}{T_1} = V_2$$

$$\text{or } T_2 = \frac{V_2T_1}{V_1}$$

By putting the values

$$T_2 = \frac{118 \times 296}{87.5} = 399K$$

T_2 can be converted into Celsius scale

T_2 = 399-273 = 126^0C

6) A sample of gas is cooled at constant pressure from 30^0C to 10^0C. Comment:

a. will the volume of the gas decrease to one third of its original volume?

b. if no, then by what ratio will the volume decrease?

Solution

$T_1 = 30^0C = 303K$

$T_2 = 10^0C = 283K$

Suppose that

$V_1 = x$

$V_2 = ?$

By using the equation

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

or
$$\frac{V_2}{V_1} = \frac{T_2}{T_1}$$

By putting the values

$$\frac{V_2}{x} = \frac{283}{303}$$

$$V_2 = 0.93x$$

As we taken ratio b/w

$V_1 : V_2$

$x : 0.93x$

$1 : 0.93$

The above ratio shows that the volume of gas V_2 cannot decrease to one third of its original volume and new ratio become 1: 0.93

7) A balloon that contains 1.6 dm^3 of air at standard temperature and pressure is taken under water to a depth at which its pressure increase to 3.0 atm. Suppose that temperature remain unchanged, what would be the new volume of the balloon. Does it contract or expand?

Solution

$V_1 = 1.6\ dm^3$

$V_2 = ?$

$P_1 = 760mmHg$

$P_2 = 3.0\ atm$

By using the equation

$P_1V_1 = P_2V_2$

$$\text{or } V_2 = \frac{P_1V_1}{P_2}$$

By putting their values

$$= \frac{1\times1.6}{3}$$

$$V_2 = 0.53dm^3$$

Thus, Balloon contracts.

8) A sample of neon gas occupies 75.0 cm^3 at very low pressure of 0.4 atm. Assuming temperature remain constant what would be the volume at 1.0 atm. Pressure?

Solution

$V_1 = 75\ cm^3$

$P_1 = 0.4$ atm

$P_2 = 1$ atm

$V_2 = ?$

By using the equation of Boyle's law.

$$P_1V_1 = P_2V_2$$

$$\text{or } V_2 = \frac{P_1V_1}{P_2}$$

By putting the values

$$= \frac{0.4\times75}{1}$$

$$V_2 = 30cm^3$$

9) A gas occupies a volume of 35.0 dm^3 at 17 ^{0}C. If the gas temperature rises to 34^{0}C at constant pressure, would you expect the volume to double? If not calculate the new volume.

Solution

$V_1 = 35.0\ dm^3$

$T_1 = 17^0C = 290K$

$T_2 = 34^0C = 307K$

$V_2 = ?$

Volume will not be double because the temperature is not double

By using the equation of Charles's law.

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$\text{or } V_2 = \frac{V_1 T_2}{T_1}$$

$$= \frac{35 \times 307}{290}$$

$$V_2 = 37.05 dm^3$$

10) The largest moon of Saturn is Titan. It has atmospheric pressure of 1.6×10^5 Pa. What is the atmospheric pressure in atm? Is it higher than earth's atmospheric pressure?

Solution.

$P = 1.6 \times 10^3$ Pa

Suppose atmospheric pressure in atm = x

Then

Pa	=	**atm**
101325		1
1.6×10^3		x

$$x = \frac{1.6 \times 10^3}{101325}$$

$$= 1.58 \text{ atm}$$

It will be cleared that the atmospheric pressure of Titan is greater than the atmosphere pressure of earth.

Short Answer Questions

Q1. Define Matter.

Ans. Everything which occupies some space and has mass is called matter

For example; Air, Wood, H_2SO_4 etc

Q2. Write down the names of different states of matter.

Ans. There are three states of matter

(i) Solid

(ii) Liquid

(ii) Gas

Q3. Describe gaseous state of matter.

Ans. Matter in gaseous state does not have definite shape and volume. Therefore, gases occupy all the available space. Gases have very weak intermolecular forces.

Q4. Define Diffusion. On what factor diffusion of gases depends?

Ans. Diffusion is spontaneous mixing up of molecules by random motion and collisions to form a homogeneous mixture

Factors

Rate of diffusion depends upon the molecular mass of the gas

Q5. Define Effusion. On what factor it depends?

Ans. It is escaping of gas molecules through a tiny hole into a space with lesser pressure. Example when a tyre gets punctured air effuses out.

Factor

Effusion depends upon the molecular masses of gases

Q6. Define Pressure. Writes down its SI unit.

Ans. Pressure

The force (F) exerted per unit surface area (A)

$$P = F/A$$

S.I unit of pressure

The SI unit of force is Newton and that of area is m^2. Hence pressure has SI unit of Nm^{-2}

It is also called Pascal (Pa)

One Pascal (Pa) = 1 Nm^{-2}

Q7. Write down the name of instruments with the help of, we measure the pressure?

Ans. There are two instruments with the help of we measure the pressure

(i) Barometer.

Barometer is used to measure the atmosphere pressure

(ii) Manometer

It is used to measure the pressure in laboratory.

Q 8. Define standard atmospheric pressure.

Ans. It is defined as the pressure exerted by a mercury column of 760mm height of sea level. It is sufficient pressure to support a column of is mercury in height at sea level.

Q 9. How Gases are compressible?

Ans. Gases are highly compressible due to empty spaces between their molecules.

Q10. Describe the mobility of gas molecules.

Ans. Gas molecules are always in state of continuous motion. They can move from one place to another because gas molecules possess very high kinetic energy.

Q11. Describe the density of gases.

Ans. Density is the ratio of mass and volume (m/v). Gases have low density than liquid and solids. Density of gases is expressed in grams per dm^3.

Q12. Why the rate of diffusion of gases is rapid than that of liquid?

Ans. Because gas molecules have insignificant intermolecular forces as compare to liquid. So the rate of diffusion of gases is rapid than that of liquid.

Q13. what do you mean by Pascal? How many Pascal are equal to 1atm?

Ans. Pascal is the SI unit of pressure

One Pascal = 1 Nm^{-2}

Q14. Whether the density of a gas decrease on cooling.

Ans. The density of gases increases by cooling because their volume decreases. For example at normal atmospheric pressure the density of oxygen gas is 1.4 gdm^{-3} at 20^0C and 1.5 gdm^{-3} at 0.0^0C

Q15. Why is the density of gas measured in $gmdm^{-3}$, while that of a liquid is expressed in gcm^{-3}?

Ans. Gases have low densities due to light mass and more volume occupied by the gas molecules. That is why gas density is expressed in grams per dm^3, whereas liquid and solid densities are expressed in gram per cm^3 because liquids and solid are 1000 times denser than gases.

Q16. Convert the following

a) 70 cm of Hg to atm

Ans. we know that

$$760 \text{ cm Hg} = 1 \text{ atm}$$
$$1 \text{ cm Hg} = \frac{1}{760}$$
$$70 \text{ cm Hg} = \frac{1}{760} \times 70$$
$$= 0.0921 \text{ atm}$$

b) 3.5 atm to torr

$$1\text{atm} = 760 \text{ torr}$$
$$3.5 \text{ atm} = 760 \times 3.5$$
$$= 2660 \text{ torr}$$

c) 1.5 atm to Pa

$$1\text{atm} = 101325 \text{ Pa}$$
$$1.5\text{atm} = 101325 \times 15$$
$$= 1511987.5 \text{ Pa}$$

Q17. Define Boyle's law.

Ans. Volume of a given mass of a gas is inversely proportional to its pressure provided the temperature remains constant.

Q18. Who was Robert Boyle?

Ans. Robert Boyle (1627-1691) was natural philosopher, chemist, physicist and inventor. He is famous for Boyle's law of gases.

Q19. Is the Boyle's law applicable to liquids?

Ans. No, Boyle's law only applicable on gas.

Q20. Is the Boyle's law valid at very high temperature?

Ans. No, it is only valid at constant temperature.

Q21. What will happen if the pressure on a sample of gas is raised three times and its temperature is kept constant?

Ans. If the pressure on a sample of gas is raised three times at constant temperature, the volume will also decrease three times of its original volume.

Q22. Who was J. Charles?

Ans. J Charles (1746-1823) was a French inventor, scientist, mathematician and balloonist. He described in 1802, how gases tend to expand when heated.

Q23. Define Charles law.

Ans. J Charles in 1789 presented his law that "the volume of a given mass of a gas is directly proportional to the absolute temperature if the pressure is kept constant.

Q24. What is absolute temperature scale?

Ans. Lord Kelvin introduced absolute temperature scale or Kelvin scale. This scale of temperature starts from 0 K or -273.15 ^{O}C which is given the name of absolute zero. It is the temperature at which an ideal gas would have zero volume.

Q25. Which parameters are kept constant in Charles's Law?

Ans. In Charles law pressure remains constant.

Q26. Why volume of gas decreases with increase of pressure?

Ans. The volume of gas decreases with increase of pressure because pressure and volume both are inversely proportional to each other so when we increase pressure, volume will decrease and when volume increases, pressure will be decreased.

Q27. Does Kelvin scale show a negative temperature?

Ans. The Kelvin scale does not show negative value, as OK = –273C^{o}.

Q28. When a gas is allowed to expand, what will be its effect on its temperature?

Ans. Temperature will be increased because volume and temperature is directly proportional to each other.

Q29. Can you cool a gas by increasing its volume?

Ans. Yes, by sudden increasing the volume of a gas, it gives the cooling effect.

Q30. In which units' body temperature is measured?

Ans. Body temperature is measured in Fahrenheit scale. Normal body temperature is 98.6 ^{O}F. and is equivalent to 37 ^{O}C. This temperature is close to average normal atmospheric temperature.

Q31. What is meant by liquid?

Ans. Matter that has indefinite shape but a definite volume is called liquid. For example water, milk etc.

Q32. Define evaporation. On which factors it depends.

Ans. The process of escaping molecules spontaneously from the surface of a liquid is called evaporation. It depends upon following factors.

(i) Temperature

(ii) Surface tension

(iii) Intermolecular forces

Q34. Explain evaporation causes cooling.

Ans. When the high kinetic energy molecules vapourize the temperature of remaining molecules falls down. To compensate this deficiency of energy, the molecules of liquid absorb energy from the surrounding. As a result the temperature of surrounding decreases and we feel cooling.

Q35. Define vapour pressure.

Ans. The pressure exerted by the vapour of a liquid at equilibrium with the liquid at a particular temperature is called vapour pressure of a liquid.

Q36. Write down the names of factors on which vapour pressure depends.

Ans. There are following factors

- **(i)** Nature of liquid
- **(ii)** Size of molecule
- **(iii)** Temperature

Q37. Define boiling point.

Ans. "The temperature at which the vapour pressure of a liquid is equal to atmospheric pressure on its surface is called boiling point"

Q38. Write down the names of factors on which boiling point depends.

Ans. The factors on which boiling point depends are

- **i)** Nature of liquid
- **ii)** Intermolecular forces
- **iii)** External pressure

Q39. Define freezing point.

Ans. Freezing point of a liquid is that temperature at which vapour pressure of liquid phase is equal to the vapour pressure of the solid phase. At this temperature liquid and solid coexist in dynamic equilibrium with one another.

Q40. Define diffusion. In which factors diffusion of liquid depends?

Ans. "The spontaneous movement of molecules from the region of higher concentration to the region of lower concentration is called diffusion"

Factors

- **(i)** Intermolecular forces
- **(ii)** Size of molecules
- **(iii)** Shape of molecules
- **(iv)** Temperature

Q41. Describe density of liquid.

Ans. The density of liquid depends upon its mass and volume. Liquid are denser than gases because molecules of liquids are closely packed and spaces between their molecules are negligible. The density of liquid is expressed in the gram per cm^3.

Q42. Why does evaporation increases with increase in temperature?

Ans. The evaporation increases with increase in temperature because kinetic energy of the molecules increases with increase in temperature. This K.E is so high that they overcome the intermolecular forces and evaporate rapidly.

Q43. What do you mean by condensation?

Ans. The process of moving the molecules from the vapours phase back into the liquid phase is called condensation.

Q44. Why the vapour pressure is higher at high temperature?

Ans. At high temperature the vapour pressure is higher than at low temperature. When temperature increases the kinetic energy of the molecules increases enough to enable them to vapourize and exerts pressure so the vapour pressure increases at high temperature.

Q45. Why the boiling point of water is higher than of alcohol?

Ans. The boiling point of water is higher than of alcohol because water has stronger inter molecular forces.

Q46. What do you mean by dynamic equilibrium?

Ans. When the rate of evaporation becomes equal to rate of condensation at stage, the number of molecules evaporating will be equal to the number of molecules coming back to liquid. This state is called dynamic equilibrium.

Q47. Why are the rate of diffusion in liquid slower than that of gas?

Ans. The rate of diffusion in liquid slower than that of gas because liquid has stronger intermolecular forces as compared to gases so the rate of diffusion is slower than that of gases.

Q48. Why does the rate of diffusion increase with increase in temperature?

Ans. Diffusion increases by increasing temperature because at high temperature the intermolecular forces are weak, so rate of diffusion increases.

Q49. Why are liquids mobile?

Ans. The ease of flow of liquid is called mobility. Because the ease of flow of liquid depends upon the strength of intermolecular attractive forces. The weaker the strength of these forces, the more mobile is the liquid and vice versa. Due to this mobility of molecules, liquid can be poured from one vessel to another vessel.

Q50. What is meant by solid?

Ans. Matter that has a definite shape and volume is called solid. For example wood, coal, plastic etc.

Q51. Define melting point.

Ans. The temperature at which a solid substance is converted into a liquid is called melting point of the solid substance.

Q52. Explain the rigidity of solid.

Ans. The particles of solids are not mobile. They have fixed positions. Therefore solids are rigid in their structure.

Q53. Explain density of solid.

Ans. Solids are denser than liquids and gases because solid particles are closely packed and do not have empty space between their particles. So they have high density as compare to liquid and gases.

Q54. Define amorphous solids. Give example.

Ans. Amorphous solids means shapeless solid in which the particles are not regularly arranged or their regular shapes are destroyed.

Example: Plastics, rubber and even glass are amorphous solids.

Q55. Define crystalline solids. Give example.

Ans. Solids in which particles are arranged in a definite three dimensional patterns are called crystalline solids.

Example: Diamond, sodium chloride etc.

Q56. Define allotropy and give any two examples.

Ans. The phenomenon in which an element exists in different forms having different physical properties but same chemical properties is called allotropy.

Examples

(i) Carbon has three allotropic forms e.g., Diamond, Graphite and Bucky balls

(ii) Sulphur has two allotropic forms e.g., Rhombic sulphur and Monoclinic sulphur

Q57. Define transition temperature. Give example.

Ans. The temperature at which one allotrope changes into another is called transition temperature.

Example

$$S_8 \text{ (Rhombic)} \xrightleftharpoons{96^0C} S_8 \text{ (monoclinic)}$$

Q58. In which form of sulphur exists at room temperature?

Ans. Rhombic Sulphur exists at room temperature.

Q59. Why is white tin available at room temperature?

Ans. The transition temperature of two allotropic forms of tin is 18^OC. So this temperature indicates white tin is more stable above 18^OC.

Q60. Why the melting point of a solid is considered its identification characteristics?

Ans. Because the solid particles possess only vibrational kinetic energy. When solids are heated their vibrational energies increase and particles vibrate at their mean position with a high speed.

Q61. Which is lightest one, aluminum or gold?

Ans. Aluminum is lighter than gold because the density of aluminum is lesser than gold. For example density of aluminum is 2.70 gcm^{-3} and gold is 9.3 gcm^{-3}.

Q62. Write the molecular formula of a sulphur molecule?

Ans. Formula of sulphur molecule is S_8.

Q63. Which allotropic form of carbon is stable at room temperature ($25^{O}C$)?

Ans. Diamond, graphite and Bucky balls are stable forms of carbon at room temperature. Among these allotropic forms graphite is energetically slightly more stable than diamond.

Q64. State whether allotropy is shown by elements or compounds or both.

Ans. Allotropy is shown by only elements because the existence of an element in more than one forms in same physical state, on the other hand compound do not show this property

Q65. What is diffusion? Explain with an example.

Ans. "The spontaneous movement of molecules from the region of higher concentration to the region of lower concentration is called diffusion"

Example

For example when a few drops of ink are added in a beaker of water, ink molecules move around and after a while spread in whole of the beaker

Q66. Define standard atmospheric pressure. What are its units? How it is related to Pascal?

Ans. It is the pressure exerted by the atmosphere at the sea level. " It is the pressure exerted by a mercury column of 760 mm height at sea level.

$$1 \text{ atm} = 760 \text{ mm of Hg} = 760 \text{ torr}$$

$$(1 \text{ mm of Hg} = \text{one torr})$$

$$= 101325 \text{ Nm}^{-2} = 101325 \text{ Pa}$$

Q67. What do you mean by evaporation? How it is affected by surface area?

Ans. The process of changing of a liquid into a gas phase is called evaporation. Evaporation is a surface phenomenon. Greater is the surface area greater is, evaporation and vice versa.

Q68. In which form sulphur exists at $100^{O}C$

Ans. Sulphur exists in monoclinic form at $100^{O}C$.

Q.69. What is the relationship between evaporation and boiling point of a liquid?

Ans. A liquid having higher boiling point will have slow evaporation due to stronger inter molecular forces. A liquid having low boiling point will have faster evaporation.

Multiple Choice Questions

1. How many states of matter exist?
(a) One (b) Two
(c) Three (d) Four

2. Matter in which state does not have definite shape and volume?
(a) Solid (b) Liquid
(c) Gas (d) All

3. Pressure is a significant property of
(a) Solid (b) Liquid
(c) Gas (d) None of them

4. Rate of diffusion depends upon the
(a) Shape of the gas
(b) Size of the gas
(c) Molecular mass of the gas
(d) All of them

5. How many times hydrogen gas diffuse faster than oxygen gas?
(a) 2 times (b) 3 times
(c) 5 times (d) 4 times

6. A tyre gets punctured is the example of:
(a) Diffusion (b) Effusion
(c) Pressure (d) Volume

7. The S.I unit of pressure is
(a) Nm^2 (b) Nm^{-2}
(c) Nm^3 (d) Nm^{-3}

8. Which one is used to measure atmospheric pressure?
(a) Barometer (b) Manometer
(c)Thermometer (d) Galvanometer

9. Which one is used to measure pressure in the laboratory?
(a) Barometer (b) Manometer
(c) Thermometer (d) Galvanometer

10. 1atm is equal to
(a) 760torr (b) 780torr
(c) 790torr (d) 800torr

11. Density of gas is expressed in
(a) $g\ dm^{-3}$ (b) $g\ cm^{-3}$
(c) Kg (d) gdm^3

12. Density of oxygen gas at 20 ^oC
(a) 1.2 gdm^{-3} (b) 1.3 gdm^{-3}
(c) 1.4 gdm^{-3} (d) 1.6 gdm^{-3}

13. Density of oxygen gas at 0^oC
(a) 1.1 gdm^{-3} (b) 1.2 gdm^{-3}
(c) 1.4 gdm^{-3} (d) 1.5 gdm^{-3}

14. Robert Boyle studied the relationship between the volume and pressure of a gas at constant temperature in:
(a) 1660 (b) 1662
(c) 1663 (d) 1664

15. When the pressure of 2atm is applied, the volume of the gas reduces:
(a)$1dm^3$ (b) $2dm^3$
(c)$3dm^3$ (d)$4dm^3$

16. When the pressure is increased to 4atm, the volume of the gas reduces:
(a) $1dm^3$ (b) 0.5 dm^3
(c) 0.33 dm^3 (d) 0.25 dm^3

17. When the pressure is increased to 6atm, the volume of the gas reduces:
(a) $1dm^3$ (b) 2 dm^3
(c) 0.5 dm^3 (d) 0.33 dm^3

18. When the pressure is increased to 8atm, the volume of the gas reduces
(a) $1dm^3$ (b) 0.5 dm^3
(c) 0.33 dm^3 (d) 0.25 dm^3

19. Blood pressure is measured by using

(a) Barometer (b) Manometer

(c) Thermometer (d) Pressure gauge

20. French scientist J. Charles presented his gas law in

(a) 1667 (b) 1787

(c) 1790 (d) 1795

21. Body temperature is measured in

(a) Celsius scale

(b) Fahrenheit scale

(c) Kelvin scale (d) both a & b

22. Evaporation is the process

(a) Exothermic (b) Endothermic

(c) Both of them (d) None of these

23. In which factor evaporation depends

(a) Temperature

(b) Surface tension

(c) Intermolecular forces

(d) All of them

24. Vapour pressure of liquid depends upon the factors

(a) Nature of liquids

(b) Size of molecule

(c) Temperature

(d) All of them

25. At $0^{o}C$ the vapour pressure of diethyl ether is

(a) 100 mmHg (b) 200 mmHg

(c) 300 mmHg (d) 400 mmHg

26. At $0^{o}C$ the vapour pressure of ethyl alcohol is

(a) 20 mmHg (b) 22 mmHg

(c) 25 mmHg (d) 30 mmHg

27. On what factors the boiling point depends upon?

(a) Nature of liquid

(b) Intermolecular forces

(c) External pressure

(d) All of them

28. Density of liquid is expressed in

(a) gdm^{3} (b) gdm^{-3}

(c) gcm^{3} (d) gcm^{-3}

29. Which state of matter has fixed shape and volume?

(a) Solid (b) Liquid

(c) Gas (d) All of them

30. Density of aluminum is

(a) 2 gcm^{-3} (b) 2.60 gcm^{-3}

(c) 2.70 gcm^{-3} (d) 2.80 gcm^{-3}

31. Density of iron is

(a) 7 gcm^{-3} (b) 7.86 gcm^{-3}

(c) 7.90 gcm^{-3} (d) 7.92 gcm^{-3}

32. Density of gold is

(a) 9 gcm^{-3} (b) 9.2 gcm^{-3}

(c) 9.3 gcm^{-3} (d) 9.4 gcm^{-3}

33. Example of amorphous solid is

(a) Plastic (b) Glass

(c) Rubber (d) All of them

34. Which one is crystalline solid?

(a) Diamond

(b) Sodium chloride

(c) Plastic

(d) Both a and b

35. Allotropes of oxygen are

(a) 2 (b) 3

(c) 4 (d) 5

36. The temperature at which two allotropic forms co-exist is called

(a) Absolute temperature

(b) Transition temperature

(c) Normal temperature

(d) Standard temperature

37. Transition temperature of phosphorous is

(a) $200^{o}C$ (b) $220^{o}C$

(c) $250^{o}C$ (d) $260^{o}C$

38. Transition temperature of tin is

(a) $15\,^{o}C$ (b) $18\,^{o}C$

(c) $20\,^{o}C$ (d) $22\,^{o}C$

Answer Key

1.	c	2.	c	**3.**	c	**4.**	c	**5.**	d
6.	b	**7.**	b	**8.**	a	**9.**	b	**10.**	a
11.	a	**12.**	c	**13.**	d	**14.**	b	**15.**	a
16.	b	**17.**	d	**18.**	d	**19.**	d	**20.**	b
21.	b	**22.**	b	**23.**	d	**24.**	d	**25.**	b
26.	c	**27.**	d	**28.**	d	**29.**	a	**30.**	c
31.	b	**32.**	c	**33.**	d	**34.**	d	**35.**	a
36.	b	**37.**	c	**38.**	b				